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No. Hei 7[1995]-90747

BASE FABRIC FOR NON-COATED AIR BAGS

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BASE FABRIC FOR NON-COATED AIR BAGS

[Non-kohto eah bagguyoh kifu]

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[There are no amendments to this patent.]

Claims /2*

1. A base fabric for a non-coated air bag consisting of a woven fabric with low air permeability and high density and having a cover factor of at least 2000 and an air permeability of 0.5 cc/cm^2/sec or less, the base fabric for non-coated air bags being characterized by the fact that both the warp and the weft synthetic fiber filament yarns comprising the aforementioned woven

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* [The numbers in the right margin indicate pagination of the original text.]

fabric are interlaced so that they have interlacing points at intervals of 10-50 mm in water, and the oil content adsorbed onto the aforementioned woven material is 0.1 wt% or below.

2. The base fabric for a non-coated air bag described in Claim 1, characterized by the fact that the aforementioned woven material with high density is a fiber selected from among nylon 66, nylon 6, nylon 46, and polyethylene terephthalate fibers.

3. The base fabric for a non-coated air bag described in Claim 1 or 2, characterized by the fact that the size of the fiber filament comprising the woven material with high density is 500 denier or less and the size of a monofiber is 4 denier or less.

Detailed explanation of the invention

[0001]

Industrial application field

The present invention pertains to a base fabric for non-coated air bags and the invention further pertains to a base fabric for non-coated air bags with improved mechanical properties, air permeability, flame retardancy, and having excellent lightness of weight, flexibility, and storage ease.

[0002]

Prior art

The installation of air bags used as a protective safety device for passengers of vehicles has been strongly and rapidly promoted in recent years.

[0003]

In general, air bags are stored in a small space such as in steering wheels and instrument panels and a reduction in the storage capacity required for the aforementioned bags is desired.

[0004]

Therefore, the properties required for the base fabric for air bags are, first of all, good folding performance while satisfying the requirement for sufficient mechanical strength and good storage ease, and in order to satisfy the aforementioned properties, many attempts have been made to minimize the storage capacity required for air bags.

[0005]

For example, in the case of a rubber-coated base fabric, a shift from polychloroprene rubber to silicone rubber has been promoted, and in this case, the coated ratio of the rubber coating can be

reduced when a silicone type rubber is used and furthermore, a softer rubber-coated base fabric can be produced.

[0006]

Furthermore, in recent years, the development of a base fabric for a non-coated air bag with the absence of a rubber coating has been promoted. In other words, a base fabric for a non-coated air bag offers the greatest advantage from the standpoint of flexibility, storage ease, and lightness of weight, and application of the aforementioned material as the base fabric for the next generation of air bags is expected.

[0007]

And the problem to be solved is to improve the properties of a base fabric for non-coated air bags to a practical level to obtain properties such as the low air permeability and flame retardance of a rubber-coated base fabric while maintaining the aforementioned properties such as high flexibility, storage ease, and lightness of weight.

[0008]

Based on the aforementioned background, many suggestions concerning the base fabric for a non-coated air bag have appeared and as typical examples of the prior art, the technologies disclosed in Japanese Kokai Patent Application No. Hei 4[1992]-2835, Japanese Kokai Patent Application No. Hei 3[1991]-134245, Japanese Kokai Patent Application No. Hei 1[1989]-122752 and Japanese Kokai Patent Application No. Sho 64[1989]-70247 can be mentioned.

[0009]

In other words, the technology disclosed in the aforementioned Japanese Kokai Patent Application No. Hei 4[1992]-2835 concerns a base fabric for a non-coated air bag with low air permeability produced by providing a calender treatment for a polyester fiber woven fabric and a method of manufacturing same.

[0010]

And the technology disclosed in the aforementioned Japanese Kokai Patent Application No. Hei 3[1991]-134245 concerns a non-coated base fabric comprising a woven fabric having a symmetrical weave provided with a calender treatment and made of a highly shrinkable yarn having a fiber size in the range of 300-400 dtex.

[0011]

Furthermore, the technology disclosed in the aforementioned Japanese Kokai Patent Application No. Hei 1[1989]-122752 is a base fabric for non-coated air bag in which the base fabric itself is made of a woven fabric having a high density, and a shrinkage treatment and heat-set calendering process are further provided to control the gas permeability, which is an important feature of a base fabric for a non-coated air bag.

[0012]

And furthermore, the technology disclosed in the aforementioned Japanese Kokai Patent Application No. Hei 64[1987]-70247 is a base fabric for non-coated air bag produced by conducting a calender treatment for a base fabric having a weight per unit area of 250 g/m^2 or below to achieve an air permeability of 5 $cc/cm^2/sec$ or below.

[0013]

In this case, it is disclosed that the base fabric for the non-coated air bag disclosed in each of the aforementioned publications offers a material having superior lightness of weight, flexibility, and storage ease as well as practical mechanical properties and a low air permeability in comparison to conventional base fabrics for air bags coated with polychloroprene rubber or silicone rubber.

[0014]

It is most effective to use a thin monofilament fiber with a small fiber size for production of a base fabric for a non-coated air bag having the aforementioned properties, but the disadvantage of the aforementioned woven fabric is insufficient tear strength, and improvement in the aforementioned property is highly desirable.

[0015]

However, improvement in the tear strength of a woven material with a high density comprising the aforementioned thin monofilament with a fine fiber size is not disclosed or even suggested in the aforementioned prior art.

[0016]

Problems to be solved by the invention

The present invention is intended to eliminate the problems of the aforementioned prior art.

[0017]

Based on the above background, the objective of the present invention is to provide a woven material with high density having excellent lightness of weight, flexibility, and storage ease, and furthermore, improved mechanical properties, especially, tear strength, air permeability, and flame retardancy, which material is woven by a water-jet loom (hereinafter referred to as WJL) with excellent weaving efficiency. /3

[0018]

As a result of much research conducted by the inventors of the present application in an effort to achieve the aforementioned objective, the inventors discovered that production of a base fabric for non-coated air bags that satisfies the aforementioned target properties is made possible when a fiber material provided with a specific interlacing is used and an adsorbed oil solution is controlled to a specific range using a base fabric for non-coated air bags comprising a woven material made of ultra-fine fibers, and as a result, the present invention was accomplished.

[0019]

Means to solve the problem

In other words, the base fabric for non-coated air bags of the present invention is a base fabric for non-coated air bags characterized by the fact that both the warp and the weft synthetic fiber filament yarns comprising the aforementioned woven fabric are interlaced in water, so as to have interlacing points at intervals of 10-50 mm, and the oil content adsorbed on the aforementioned woven material is 0.1 wt% or below in a base fabric for non-coated air bags consisting of a woven fabric with low air permeability and high density and having a cover factor of at least 2000 and an air permeability of 0.5 $cc/cm^2/sec$ or below.

[0020]

Furthermore, the base fabric for non-coated air bags of the present invention is characterized by the fact that the aforementioned woven material with high density is made of a fiber selected from among nylon 66, nylon 6, nylon 46, and polyethylene terephthalate.

[0021]

And furthermore, the base fabric for non-coated air bags of the present invention is characterized by the fact that the size of the fiber filament comprising the woven material with high density is 500 denier or less and the size of a monofiber is 4 denier or less.

[0022]

The base fabric for non-coated air bags of the present invention has excellent lightness of weight, flexibility, and storage ease, and furthermore, improved mechanical properties, especially, tear strength, air permeability, and flame retardancy, a specific interlacing is provided for the material fiber of the woven material comprising the base fabric and furthermore, the adsorbed oil content on the aforementioned woven material is controlled within a specific range.

[0023]

The fiber used for the base fabric for non-coated air bags of the present invention is made of a fiber selected from among nylon 66, nylon 6, nylon 46, and polyethylene terephthalate. In general, it is desirable if the aforementioned fiber is made of a single polymer, but 10 wt% or less of a copolymeric component may be included. Especially when nylon 46 is used, spinning is difficult when a homopolymer is used due to the high melting point and high crystallinity; thus, it is further desirable if approximately 5 wt% of a copolymeric component, for example, a copolymer polyamide fiber containing ε-caprolactom, is included.

[0024]

It is necessary to use a polymer with a high degree of polymerization for the fiber having a hollow cross section of the present invention to provide sufficiently good mechanical properties for the base fabric, in other words, sufficient strength of the base fabric that can withstand the instantaneous expansion of gas, especially, high impact strength, rupture strength, and tear strength, and that can withstand absorption of the energy of the impact when the expanded air bag hits the passenger. In specific terms, a viscosity relative to sulfuric acid (ηr) of at least 3.0 is required when nylon 66, nylon 6, and nylon 46 are used and an intrinsic viscosity ($[\eta]$) of at least 0.8 is required when polyethylene terephthalate is used.

[0025]

Furthermore, when a fiber made of nylon 66, nylon 6, or nylon 46 is used for the base fabric for the non-coated air bags of the present invention, it is desirable if an antioxidant is included to avoid a thermal history [effect] during the course of production of the filament yarn and to prevent thermal degradation, light deterioration, and oxidation during the course of storage and use as a product. For antioxidants, copper salts of organic or inorganic acids such as copper iodide, copper bromide, copper chloride, copper acetate, copper pyrophosphate, and copper stearate can be added in an amount in the range of 10-300 ppm, preferably, in an amount in the range of 20-150 ppm, as the copper salt, and furthermore, it is further desirable if an alkali metal halide, alkaline earth metal halide, or a halogenated quaternary ammonium salt such as potassium iodide, potassium bromide,

potassium chloride, sodium iodide, sodium bromide, sodium chloride, lithium iodide, lithium bromide, or lithium chloride is additionally used in an amount in the range of 0.05-0.5 wt%. In addition, either an organic or inorganic phosphorus compound may be included as a phosphorus compound in an amount in the range of 10-500 ppm in some cases.

[0026]

Furthermore, in the case of polyethylene terephthalate fibers, it is desirable if the concentration of the carboxyl end groups is 30 eq/10^6 or less, preferably, 20 eq/10^6 or less, to prevent a hydrolysis reaction. Production of a polyethylene terephthalate fiber having a low carboxyl end group content can be achieved by using a low temperature polymerization process or by adding an epoxy compound, carbodiimide compound, or oxazoline compound at the time of the spinning process as an end blocking agent.

[0027]

In general, the size of the fiber comprising the base fabric for non-coated air bags of the present invention is 500 denier or less, and the aforementioned fiber size corresponds to the upper limit of the fiber size and enables accommodation of efficient weaving based on the WJL method suitable for production of the base fabric for non-coated air bags of the present invention.

[0028]

Meanwhile, the finer the fiber size, the more advantageous from the standpoint of lightness of weight, flexibility, and storage ease, but in order to obtain a sufficiently high level of the mechanical properties of the base fabric, the lower limit is preferably 210 denier.

[0029]

The fiber size of a monofilament of the fiber comprising the base fabric for non-coated air bags of the present invention is 4 denier or less, and preferably, 3 denier or less. In this case, the finer the fiber size, the more flexible and compact is the base fabric for the air bags.

[0030]

Furthermore, when the fiber size of the monofilament is 4 denier or less, interlacing between monofilaments is likely to be achieved and the interlacing can be retained even after weaving; thus, a higher tear strength can be achieved than with a base fabric for air bags comprising fiber with a fine monofilament of the prior art.

[0031] /4

If the fiber size of the monofilament exceeds 4 denier, sufficient improvement in the effect of the present invention, in particular, flexibility and storage ease of the base fabric for air bags, cannot be achieved, and furthermore, a strong interlacing treatment that leaves a high interlacing effect after the WJL weaving cannot be provided; thus, this is not desirable.

[0032]

The base fabric for non-coated air bags of the present invention is a woven material with high density having a low permeability of 0.5 $cc/cm^2/sec$ or less and a cover factor of at least 2000, preferably, at least 2100.

[0033]

In this case, the cover factor (K) is a value obtained from the product of the square root of the woven material structural density and the fiber size of the fiber filament according to the equation shown below.

$$K = N_W \times D_W^{1/2} + N_F \times D_F^{1/2}$$

wherein N_W: Density of warp (fibers/inch)

D_W: Denier of warp

N_F: Density of weft (fibers/inch)

D_F: Denier of weft.

[0034]

Furthermore, both the warp and weft synthetic fiber filament yarns comprising the aforementioned woven fabric are interlaced so as to have interlacing points at intervals of 10-50 mm in water.

[0035]

In other words, when the base fabric woven material of the present invention is disassembled to form warp and weft and is immersed in water, the interlacing remains and the filament yarn has interlacing points at intervals of 10-50 mm.

[0036]

In general, the finer the size of the monofilament of the filament yarn, the greater the degree of reduction in the tear strength of the woven material, and the lower the oil component adsorbed to the woven material with a high density and the higher the friction between filament yarns of the warp and weft, the greater the degree of reduction in tear strength of the woven material.

[0037]

Therefore, in order to prevent a reduction in the aforementioned tear strength, it is effective to increase the degree of the aforementioned interlacing effect and to converge the filaments comprising the fiber yarn.

[0038]

In order to leave a sufficient interlacing effect even after weaving by WJL as in the case of the base fabric for non-coated air bags of the present invention, it is necessary to provide a relatively strong interlacing effect to the filament yarn prior to weaving and a filament yarn with an interlacing having a CF value of at least 40 is used.

[0039]

However, in a base fabric for non-coated air bags woven by WJL and having a residual oil solution content of 1 wt% or less of the prior art, interlacing wherein a repeating distance can be clearly measured in water when a filament yarn is disassembled from the aforementioned base fabric is absent.

[0040]

Furthermore, the adsorbed residual oil solution is 0.1 wt% or less in the base fabric for non-coated air bags of the present invention.

[0041]

In general, the combustion point and the ignition point of the oil solution for synthetic fibers are lower than those of synthetic fibers; thus, if the oil solution that remains is 0.1 wt% or above, it is not possible to ensure sufficient flame retardancy suitable for the base fabric of non-coated air bags in some cases.

[0042]

On the other hand, as described above, the non-coated air bag of the present invention is made of a woven material with high density having an air permeability that remains below a certain level; thus, when weaving is done while the oil solution is being adsorbed, sufficient removal of the oil solution included in the woven material is possible even after the refining process that follows.

[0043]

Therefore, the base fabric for non-coated air bags of the present invention essentially means a base fabric woven by WJL and capable of having the oil solution washed away at the time of weaving.

[0044]

Furthermore, it is important to select an oil solution for adsorption to the material yarn that can be easily washed away during the course of weaving.

[0045]

For properties required for the oil solution used for the base fabric for non-coated air bags of the present invention, ① sufficient strength of the oil film for the extreme pressure at the time of contact between the filament yarn and metal with low friction between the filament and the roll so that spinning can be done without rupturing the filament or forming fuzz, ② oil solution deposited onto the heating roll that is unlikely to undergo thermal oxidation decomposition, ③ the provision of sufficient friction between filaments to accommodate sufficient interlacing for drawing the filaments together, and ④ an oil solution that accommodates easy washing at the time of the WJL weaving process, etc. can be mentioned, and it is necessary for the aforementioned properties to be in good balance.

[0046]

For oil solutions that satisfy the aforementioned properties, those made with additive components such as lubricant components, activator components, trace amounts of extreme pressure inhibitors, antistatic agents, and antioxidants can be used and as specific examples of desirable oil solution compositions, "a mixture comprising a dihydric fatty acid ester compound containing 20-50 wt% of an ester oxide with a molecular weight in the range of 600-1000 (A), a polyester type activator with a molecular weight in the range of 1000-5000 (B), and a polyethylene glycol ester compound containing 25-55 wt% of diethylene oxide with a molecular weight in the range of 600-1000 (C)" can be mentioned.

[0047]

A method of manufacturing the base fabric for non-coated air bags of the present invention is explained in further detail below.

[0048]

The raw material filament for the base fabric for non-coated air bags of the present invention can be produced by melt spinning and drawing a polyamide such as nylon 66, nylon 46, nylon 6, or a polyethylene terephthalate polymer.

[0049]

In order to satisfy the mechanical properties of the base fabric, it is desirable if the aforementioned raw material filament is made of a polymer having a high polymerization degree, and a viscosity relative to sulfuric acid (ηr) of at least 3.0 is required when nylon 66, nylon 6, or nylon 46 is used and an intrinsic viscosity ($[\eta]$) of at least 0.8 is required when polyethylene terephthalate is used.

[0050]

Furthermore, it is desirable if an antioxidant is included in order to avoid a thermal history [effect] during the course of production of the filament yarn and to prevent thermal degradation, light deterioration, and oxidation during the course of storage and application as a product when nylon 66, nylon 6, and nylon 46 are used.

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[0051]

On the other hand, in the case of a polyethylene terephthalate fiber, it is desirable if the concentration of carboxyl end groups is 30 eq/10^6 or below, preferably, 20 eq/10^6 or below, in order to prevent a hydrolysis reaction and amine decomposition.

[0052]

Hot-melt spinning is provided for the aforementioned polymer during the course of the spinning process and an oil solution is applied to the filament yarn and it is chilled to solidify.

[0053]

The oil solution is applied as a solution by diluting the aforementioned oil solution component with mineral oil with a low molecular weight or water and the adsorption ratio of the oil solution on the fiber is in the range of 0.3-1.5 wt%, in general, in the range of 0.5-1.0 wt%.

[0054]

In general, the filament yarn provided with the aforementioned oil solution is continuously supplied to the drawing process and drawing is conducted under heat. In general, a multi-stage thermal drawing process comprising two or more stages is used for drawing. The drawn filament

yarn is then provided with a heat-set and take-up and shortly before take-up, an interlacing treatment is provided for the filament yarn and filaments are mutually converged.

[0055]

The interlacing treatment is carried out by injecting a liquid under high-pressure, for example, highly compressed air or steam is injected onto the outer surface of the filament yarn through a nozzle.

[0056]

A portion of the raw material yarn produced as described above is supplied to the warping process and is taken-up as warp by a warping beam and a portion is prepared as a weft yarn and weaving is done by the WJL method.

[0057]

The base fabric for non-coated air bags of the present invention is formed into a woven material with high density having a cover factor of at least 2000 to form an air permeability of 0.5 cc/cm^2/sec or less. For example, when weaving is done to form a plain weave with a raw material yarn of nylon 66 with a fiber size of 420 denier, the yarn strand ramming density is at least 50 filaments per 1 inch for the warp and weft. It is further desirable if a woven material with high density having a cover factor of at least 2100 is formed.

[0058]

The WJL weaves efficiently at a ramming rate of approximately at least 800 m/min, preferably, at least 1000 m/min. In general, most of the oil solution adsorbed on the raw material yarn is washed off during the course of the aforementioned weaving process and the residual oil component is 0.1 wt% or below.

[0059]

In general, the woven material is supplied to the heat-set process as is without passing through a refining process and a heat-set is applied.

[0060]

In the aforementioned heat-set process, a calender treatment may be provided for one surface or both surfaces of the material so as to control the air permeability or to control to obtain the appearance or flexibility required for a base fabric for non-coated air bags.

[0061]

The base fabric for non-coated air bags of the present invention produced by the aforementioned method has superior properties as shown below.

[0062]

(1) Cover factor (K)

$K \geq 2000$

(2) Tensile strength (S)

$S \geq 160$ kg/3 cm

(JIS K6328 5.3.5)

(3) Rupture Elongation (E)

$15[\%] \leq E \geq 35\%$

(JIS K6328 5.3.5)

(4) Tear strength (TS)

$TS \geq 15$ kg

(JIS K6328 5.3.6)

(5) Air permeability (P)

$P \leq 0.5$ cc/cm^2/sec

(JIS L1096 Method 6.27A)

(6) Flammability (B)

$B \leq 50$ mm/min

(FMVSS No. 302).

[0063]

The base fabric for non-coated air bags of the present invention having the aforementioned excellent properties is light weight, flexible, and provides excellent storage ease and mechanical properties, and furthermore, practical and sufficient air non-permeability and flammability can be achieved.

[0064]

In particular, the base fabric for non-coated air bags of the present invention has advantages over base fabrics made of conventional polychloroprene rubber or silicone type rubber from the standpoint of lightness of weight, flexibility, and providing storage ease, and furthermore, production at a low cost is possible.

[0065]

The base fabric for non-coated air bags of the present invention having the aforementioned advantages can be successfully applied to the driver side as well as to the passenger side.

[0066]

An embodiment of the present invention is explained further in specific terms with the application examples below.

[0067]

Application examples

Nylon 66 chips having a viscosity relative to sulfuric acid (sample condition 1 wt%, 25°C) of 3.5 and containing 100 ppm of phosphorus, 80 ppm of copper, and 0.1 wt% of potassium iodide as antioxidants were melted by an extruder type spinning machine.

[0068]

In this case, filtration was provided for the molten polymer in a spinning pack and then, the polymer was spun from orifices of a nozzle. Furthermore, a nozzle having many orifices having a diameter of 0.25 mm was used.

[0069]

The spun yarn was passed through a slow cooling zone underneath the orifices, and the yarn was cooled by chilled air. Furthermore, an oil solution diluted to 20 wt% using a high quality hydrocarbon was applied to the aforementioned filament yarn and take-up was done by a take-up roll at a rate of 900 m/min.

[0070]

Furthermore, 5% stretch was applied to the filament yarn between the take-up roll and feed roll and the aforementioned oil solution was applied in the form of a raw material solution.

[0071]

The oil solution used in this case is a non-aqueous type mixed oil solution containing additives such as a lubricant component, an activator component, a trace amount of an extreme pressure inhibitor, an antistatic agent, and an antioxidant.

[0072]

The oil solution was applied in an amount of approximately 0.2-0.5 wt% in front of the take-up roll and the remainder was applied between the take-up roll and the feed roll so as to form an application rate of 0.5-1.5 wt%, preferably, 0.6-1.2 wt%, for the fiber taken up after a drawing process.

[0073]

Subsequently, the filament yarn was supplied to the drawing process and continuous drawing was done. The yarn was drawn under heat by means of a single stage relaxation treatment process after two-stage drawing under heat was provided.

[0074]

In this case, the take-up roll was not heated, the feeder roll was heated to 60°C, the temperature of the first drawing roll was 120°C, the temperature of the second drawing roll was 240°C, and the temperature of the relaxation roll after drawing was 120°C, respectively.

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[0075]

The drawing ratio used was 3.56 in the first stage drawing and 1.25 in the second stage drawing, and furthermore, the relaxation ratio at the relaxation treatment was 8%.

[0076]

And furthermore, an interlacing treatment was provided in such a manner that the number of interlacing points became 0-80 points per 1 m for the filament yarn shortly before take-up.

[0077]

The properties of the raw material polymer, fiber size, number of filaments, fiber size of monofilament, etc. are shown in Table 1 (application examples) and Table 2 (comparative examples) below and features of the same are shown in Table 1 and Table 2 as well.

[0078]

Table 1

	(1) 実施例1	(1) 実施例2	(1) 実施例3	(1) 実施例4	(1) 実施例5
(2) ポリマ	N66	N66	N66	N66	PET
(3) 粘度 硫酸相対粘度(4)	3.6	3.6	3.6	3.6	–
固有粘度(5)	–	–	–	–	0.93
(6) 酸化防止剤	燐(7) 100ppm	燐(7) 100ppm	燐(7) 100ppm	燐(7) 100ppm	–
	銅(8) 80ppm	銅(8) 80ppm	銅(8) 80ppm	銅(8) 80ppm	–
(9)	沃化カリウム 0.1%	沃化カリウム(9) 0.1%	沃化カリウム(9) 0.1%	沃化カリウム(9) 0.1%	–
(10) カルボキシル末端基 (eq/10^6 g)	–	–	–	–	18
(11) 繊度構成 (D-f11)	420-144	420-144	420-216	315-144	420-216
単糸繊度 (d)	2.9	2.9	1.9	2.2	1.9
繊度 (D)	421	421	422	316	420
強度 (g/d)	9.6	9.6	9.7	9.7	8.8
伸度 (%)	22.2	22.2	22.5	22.6	14.3
乾熱収縮率 (%)	1.8	1.8	1.9	1.9	9.8
沸騰水収縮率 (%)	6.1	6.1	6.2	6.2	–
CF値 (–)	65	65	74	66	80

Key:
1 Application Example __
2 Polymer
3 Viscosity
4 Viscosity relative to sulfuric acid
5 Intrinsic viscosity
6 Antioxidant
7 Phosphorus
8 Copper
9 Potassium iodide
10 Carboxyl end groups
11 Fiber structure
Monofilament fiber size
Fiber size
Strength
Elongation
Dry thermal shrinkage factor
Boiling water shrinkage factor
CF value

Table 2

	(1) 比較例1	(1) 比較例2	(1) 比較例3	(1) 比較例4
(2) ポリマー	N66	N66	N66	PET
(3) 粘度 硫酸相対粘度 (4)	3.6	3.6	3.6	–
固有粘度 (5)	–	–	–	0.93
(6) 酸化防止剤	燐 (7) 100ppm	燐 (7) 100ppm	燐 (7) 100ppm	–
	銅 (8) 80ppm	銅 (8) 80ppm	銅 (8) 80ppm	–
(9)	沃化カリウム 0.1%	沃化カリウム 0.1%	沃化カリウム 0.1%	–
(10) カルボキシル末端基 ($eq/10^6$ g)	–	–	–	18
(11) 繊度構成 (D-f)	420-72	420-72	420-144	420-216
単糸繊度 (d)	5.8	5.8	2.9	1.9
繊度 (D)	422	422	421	420
強度 (g/d)	9.6	9.6	9.7	8.9
伸度 (%)	22.0	22.4	22.4	14.5
乾熱収縮率 (%)	1.7	1.7	1.7	9.6
沸騰水収縮率 (%)	6.1	6.1	6.1	–
CF値 (–)	28	28	35	35

Key:
1 Comparative Example __
2 Polymer
3 Viscosity
4 Viscosity relative to sulfuric acid
5 Intrinsic viscosity
6 Antioxidant
7 Phosphorus
8 Copper
9 Potassium iodide
10 Carboxyl end groups
11 Fiber structure
Monofilament fiber size
Fiber size
Strength
Elongation
Dry thermal shrinkage factor
Boiling water shrinkage factor
CF value

Subsequently, weaving was carried out with the aforementioned raw material yarns. In other words, a portion of the raw material yarn was used as the warp beam and a portion of the raw material yarn was used as the weft beam and weaving was carried out at a weft running rate of 1000 m/min using a WJL from Tsudakoma Co. (Ltd.).

[0079]

Furthermore, the density of the warp and weft in the high density woven material, the cover factor, the type of loom and the calender treatment process were varied as shown in Table 3 (application examples) and Table 4 (comparative examples) so as to produce a variety of woven materials.

[0080]

It should be noted that the same raw material yarn was used in Comparative Example 3 of Table 4 using a rapier loom and in order to remove the oil solution, a refining process was provided. The refining process in this case consisted of passing the material through a warm bath at 70°C containing a scouring agent for 2 minutes.

[0081]

Furthermore, a heat-set was carried out at 180°C for each woven material so as to produce a variety of base fabrics for non-coated air bags.

[0082]

For each base fabric produced above, an evaluation of the properties for a base fabric for non-coated air bags was carried out and the results obtained are also shown in Table 3 and Table 4 below.

[0083]

/8

Table 3

	①実施例1	①実施例2	①実施例3	①実施例4	①実施例5
② 織物密度 経×緯 (本/インチ)	55 ×55	55×55	55×55	70 ×70	66×66
③ カバーファクター(－)	2254	2254	2254	2485	2705(2218**)
④ 織機タイプ	WJL	WJL	WJL	WJL	WJL
⑤ カレンダー加工有無	⑥無	⑦有	⑥無	⑥無	⑦有
⑧ 織物分解糸条の水中における交絡部の間隔 (mm)	35	30	25	22	21
⑨ 残留油分量 (%)	0.03	0.03	0.02	0.02	0.02
引張り強力 (kg/3cm)	203 ×210	190×184	208 ×202	220 ×215	201×192
破断伸度 (%)	32 ×26	34×28	34 ×28	32 ×28	30 ×24
引裂強力 (kg)	45 ×43	42×41	42 ×40	38 ×36	38×36
通気量 (cc/cm^2/sec)	0.12	0.08	0.10	0.12	0.08
柔軟性 (mm)	65 ×70	60×66	58 ×63	57×59	60×62
燃焼性 (mm/分)	15	20	25	25	28

(*: x indicates the value of the property in the vertical direction x horizontal direction.
**: The number in the ( ) indicates the value converted to the density of polyamide.)

Key:
1 Application Example __
2 Density of woven material with high density warp x weft (fibers/inch)
3 Cover factor
4 Type of weaving machine used
5 Calender treatment process
6 Not provided
7 Provided
8 Distance between interlacing points of the filament yarn of woven material with high density in water
9 Residual oil solution ratio
Tensile strength
Rupture elongation
Tear strength
Air permeability
Flexibility
Flammability (mm/min)

Table 4

	① 比較例1	① 比較例2	① 比較例3	① 比較例4
② 織物密度 経×緯 (本/インチ)	46×46	55×55	56 ×55	66 ×66
③ カバーファクター(ー)	1885*	2254	2254	2705(2218**)
④ 織機タイプ	WJL	WJL	⑤ レピア	WJL
⑥ カレンダー加工有無	⑦ 無	⑦ 無	⑦ 無	⑧ 有
⑨ 織物分解糸条の水中における交絡部の間隔 (mm)	180	105	82	112
⑩ 残留油分量 (%)	0.02	0.01	0.41	0.03
引張り強力 (kg/3cm)	212 ×210	245×232	240×238	211 ×201
破断伸度 (%)	30 ×26	35 ×30	36×31	29 ×24
引裂強力 (kg)	44 ×42	38 ×37	43×40	35 ×31
通気量(cc/cm^2 /sec)	0.72	0.65	0.12	0.70
柔軟性 (mm)	76×85	68 ×70	67 ×69	61 ×65
燃焼性 (mm/分)	42	36	85	45

(*: x indicates the value of the property in the vertical direction x horizontal direction.
**: The number in the ( ) indicates the value converted to the density of polyamide.)

Key:
1 Comparative Example __
2 Density of woven material with high density warp x weft (fibers/inch)
3 Cover factor
4 Type of weaving machine used
5 Rapier loom
6 Calender treatment process
7 Not provided
8 Provided
9 Distance between interlacing points of the filament yarn of woven material with high density in water
10 Residual oil solution ratio
11 Tensile strength
12 Rupture elongation
13 Tear strength
14 Air permeability
15 Flexibility
16 Flammability (mm/min)

As is clearly shown in the results of the aforementioned Table 3 and Table 4, all properties of the woven material with high density such as the cover factor (at least 2000), air permeability (0.5 cc/cm^2/sec or below), and low oil solution adsorption (0.1 wt% or below) specified in the present invention are satisfied and the obtained values of properties such as the air permeability, flame retardancy, flexibility, mechanical properties, in particular, tear strength, are superior in the base fabrics for non-coated air bags (Application examples 1-5) in comparison to the base fabrics for non-coated air bags of the comparisons (Comparative Examples 1-4) that do not satisfy a part or all of the aforementioned conditions.

[0084]

Furthermore, interlacing is also provided for the warp yarn and weft yarn comprising the woven material with high density of the present invention in water (10-80 interlacing points/m) and furthermore, the fiber size is 500 denier or below and the fiber size of the monofilament is 4 denier or below.

[0085]

Effect of the invention

The base fabric for non-coated air bags of the present invention has mechanical properties that match those of conventional polychloroprene rubber-coated base fabric or silicone type rubber-coated base fabric, and furthermore, sufficiently low air permeability and sufficient flame retardancy for practical application as well, and can be used as a replacement of the aforementioned rubber-coated base fabrics.

[0086]

And furthermore, in comparison to the aforementioned conventional rubber-coated base fabrics, the base fabric for non-coated air bags of the present invention has additional advantages such as low weight, high flexibility and storage ease, and a sufficiently improved tear strength can be achieved despite a filament yarn having a fiber size of 500 denier or below and a monofilament size of 4 denier or below.

[0087]

And furthermore, the base fabric for non-coated air bags of the present invention is woven by an efficient WJL loom, and furthermore, rubber coating is not required; therefore, an additional advantage of low production cost of the base fabric can be achieved.

[0088]

And therefore, the base fabric for non-coated air bags of the present invention having the aforementioned properties and an advantageous production cost contributes to a significant increase in installation of air bags for protection of passengers of vehicles.